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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/698,878	10/31/2003	Cyprian E. Uzoh	NT-308-US	1999

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EXAMINER

VAN, LUAN V

ART UNIT PAPER NUMBER

1753

DATE MAILED: 10/05/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/698,878

Applicant(s)

UZOH ET AL.

Examiner

Luan V. Van

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 August 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 8/9/04 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 8/9/04.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Drawings

Figure 1-5 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

The drawings are objected to because I3 should be I2 in Fig. 9C. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet"

Art Unit: 1753

pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-2 and 8-10 are rejected under 35 U.S.C. 102(b) as being anticipated by Dubin et al. .

Regarding claims 1-2 and 9-10, Dubin et al. teach an electrodeposition process on a plurality of workpieces, each electrodeposition process comprising the steps of: applying an initial process current density (figure 7, feature 702) as the workpiece surface enters the process solution; applying a first process current density (figure 7, feature 704) to fill the cavity with the conductive material; and applying a second process current density (figure 7, feature 706) to form a substantially flat conductive layer. In addition, Dubin et al. teach "the first, second, third, fourth, and fifth forward currents are each different from the other and monotonically increasing in this illustrative embodiment. The magnitudes of the current densities of the first, second, third, and

Art Unit: 1753

fourth currents is between 10 and 30 mA/cm² with a duration of between 2 and 60 seconds each" (column 6 lines 33-35), and this "range of current magnitudes and pulse widths provides a reduction in void formation and improved surface morphology" (column 6 lines 10-15). With respect to the first, second, and third transition current density, these current densities are arbitrary predetermined values to provide void-free conformal plating. Since the range of current densities as taught by Dubin et al. provides void-free conformal plating, any values within that range can be arbitrarily selected to serve as the first, second, or third transition current density, while maintaining their magnitude relationship. The range of current densities as taught by Dubin et al. would also be capable of forming either a flat profile or a convex profile.

Regarding claim 8, Dubin et al. teach repeating the forward current steps multiple times (column 5 lines 39-41).

Claims 1-3, 9-10 and 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Reid et al. .

Regarding claims 1-2 and 9-10, Reid et al. teach an electrodeposition process on a plurality of workpieces, each electrodeposition process comprising the steps of: applying an initial process current density (paragraph 21-22) as the workpiece surface enters the process solution; applying a first process current density (paragraph 23-25) to fill the cavity with the conductive material; and applying a second process current

Art Unit: 1753

density (paragraph 26-28) to form a substantially flat conductive layer. In addition, Reid et al. teach during the initiation phase "a low DC cathodic current in the range between 0.2 and 5 mA/cm², which may be constant or ramped, onto which are superimposed short cathodic current pulses in the range of about 25 to 250 mA/cm² with pulse lengths of about 0.5 to 10 ms at a relatively low duty cycle in the range of 0.2 to 10%" (paragraph 25); and during the bottom-up filling phase a current density in the range between 0.2 and 5 mA/cm² is used and is increased over a period in the range of about 3 to 60 seconds (paragraph 28). With respect to the first, second, and third transition current density, these current densities are arbitrary predetermined values to provide void-free conformal plating. Since the range of current densities in the initiation phase and the bottom-up filling phase as taught by Reid et al. provides void-free conformal plating (paragraph 7), any values within that range can be arbitrarily selected to serve as the first, second, or third transition current density, while maintaining their magnitude relationship. The range of current densities as taught by Reid et al. would also be capable of forming either a flat profile or a convex profile.

Regarding claim 3, the third process current density can be arbitrarily chosen from any of the phases--except the entry phase--since there are least three phases in the method of Reid et al. If the third process current density is in the initiation phase, it would have pulse lengths of about 0.5 to 10 ms, which is shorter than the first (bottom-up) and the second (low aspect ratio) times. The third process current density would

Art Unit: 1753

also be higher than the second process current density, since it has a range of about 25 to 250 mA/cm².

Regarding claim 13, Reid et al. teach the first predetermined time is shorter than the second predetermined time (example 1).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 3-7 and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin et al.

Dubin et al. teach the method as described above in addressing claims 1 and 9. The difference between the reference to Dubin et al. and the instant claims is that the reference does not explicitly teach the different sequences of various current density pulses having different durations.

However, regarding claims 3-7, Dubin et al. teach that "the magnitudes of the current densities of the first, second, third, and fourth currents is between 10 and 30 mA/cm² with a duration of between 2 and 60 seconds each" (column 6 lines 33-35); and the "forward current steps may include two or more sub-steps" (column 5 lines 39-45). Furthermore, "various combinations of forward and reverse current densities and durations may be used within the scope of the...invention" (column 6 lines 59-62).

Regarding claims 11-13, the first and second time period can be selected within the range between 2 and 60 seconds as taught by Dubin et al. such that the first time period is equal to, greater than, or less than the second time period.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Dubin et al. by using various combinations of current densities and durations, because using these combinations of parameters would yield a void-free and uniform surface morphology.

Claims 4-8 and 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reid et al. in view of Dubin et al. .

Reid et al. teach the method as described above in addressing claims 1 and 9.

The difference between the reference to Reid et al. and the instant claims is that the reference does not explicitly teach the different sequences of various current density pulses.

Regarding claims 3-8, Dubin et al. teach that "the magnitudes of the current densities of the first, second, third, and fourth currents is between 10 and 30 mA/cm² with a duration of between 2 and 60 seconds each" (column 6 lines 33-35); and the "forward current steps may include two or more sub-steps" (column 5 lines 39-45). Furthermore, "various combinations of forward and reverse current densities and durations may be used within the scope of the...invention" (column 6 lines 59-62).

Regarding claims 11-12, the first and second time period can be selected within the range between 2 and 60 seconds as taught by Dubin et al. such that the first time period is equal to or greater than the second time period.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Reid et al. by using various combinations

of current densities and durations as taught by Dubin et al. , because using these combinations of parameters would yield a void-free and uniform surface morphology.

Conclusion

The prior art made of record and not relied upon is considered pertinent to the applicant's disclosure. Hu et al. teach the relationship between deposition rate and current density and that deposition rate increases with increasing applied current (figure 9). Wang teaches the power supply output wave forms can be selected from a variety of wave forms, such as a modified sine-wave form, a unipolar pulse, a reverse pulse, a pulse-on-pulse or a duplex pulse, as shown in FIG. 44.

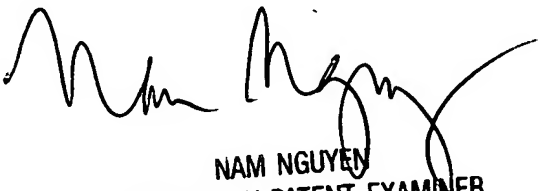
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luan V. Van whose telephone number is 571-272-8521. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 1753

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LWV
9/20/05



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